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BLACK & VEATCH





RETI Phase 2 Update Workgroup

Status Update to SSC

Black & Veatch: Ryan Pletka

January 19, 2010

Announcement

Black & Veatch has moved!

650 California, Fifth Floor

San Francisco, CA 94108

1-415-693-9552

ext. 14 Ryan Pletka

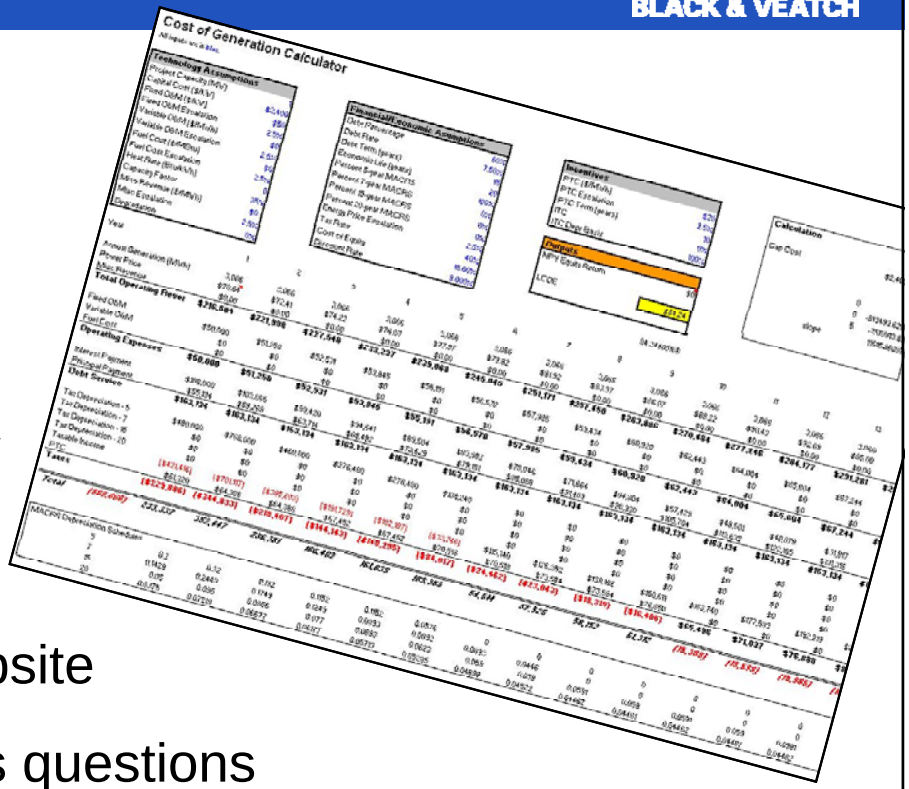
ext. 15 Tim Mason

RETI Phase 2 Update Workgroup Issues

- Economic Model Update ✓
- Extended Analysis of Out-of-State Resources
  - Screening ✓
  - Transmission Approach ✓
- CREZ and Technology Updates
  - CREZ Updates ✓
  - Technology Assumptions ✓
- Re-rank CREZs ← Soon

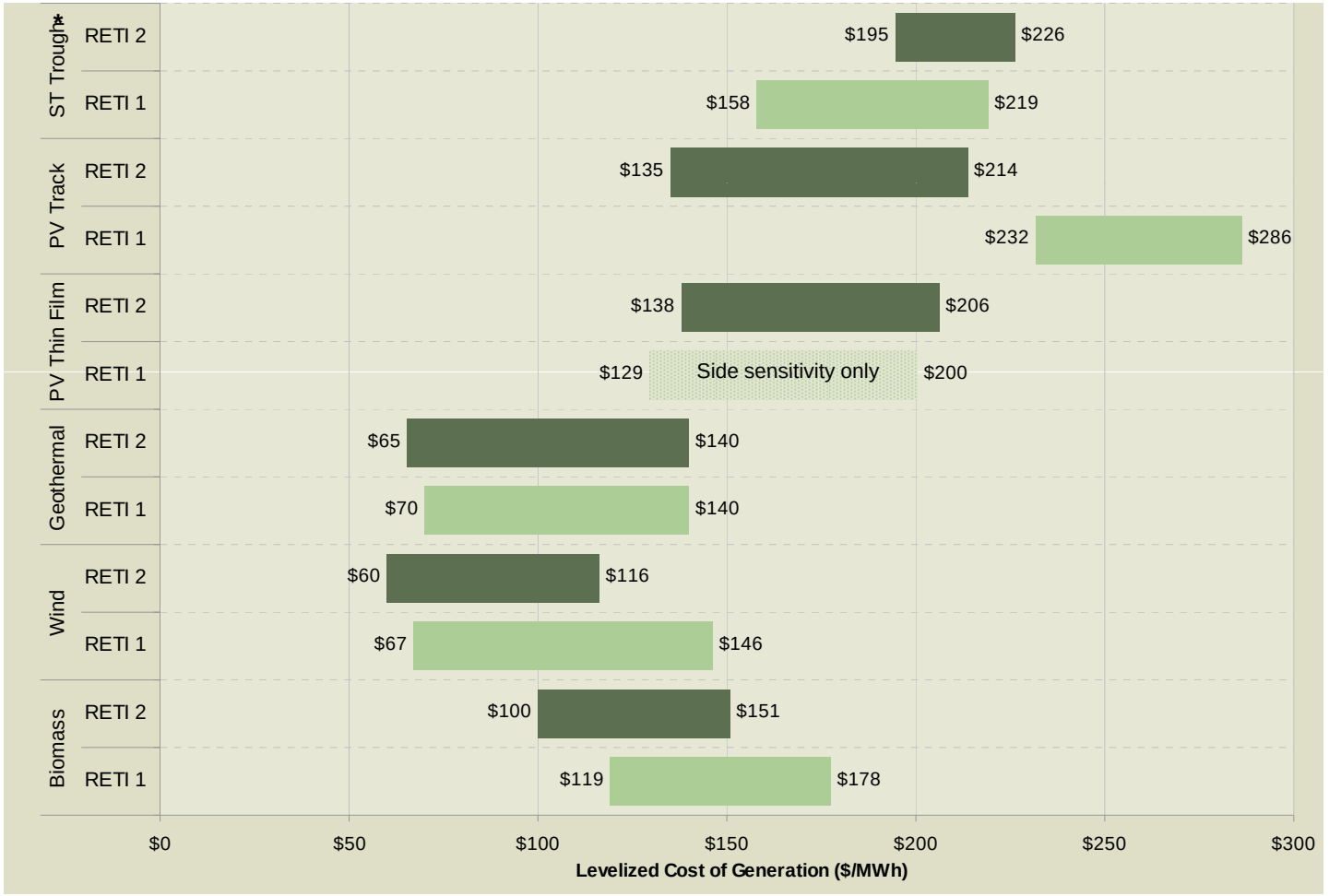
Economic Model Update

Economic Model



- Updated levelized cost of energy model
  - Changes made mostly to accommodate new incentives
  - Available on RETI website
  - Couple of clarifications questions answered
  - No material comments
  - Will assume to be good working model unless substantive issues arise

Typical Cost of Generation Ranges: Current RETI Phase 2 Black & Veatch Proposal



*Advanced solar thermal technologies also under consideration

Summary of Significant Drivers of Cost Change

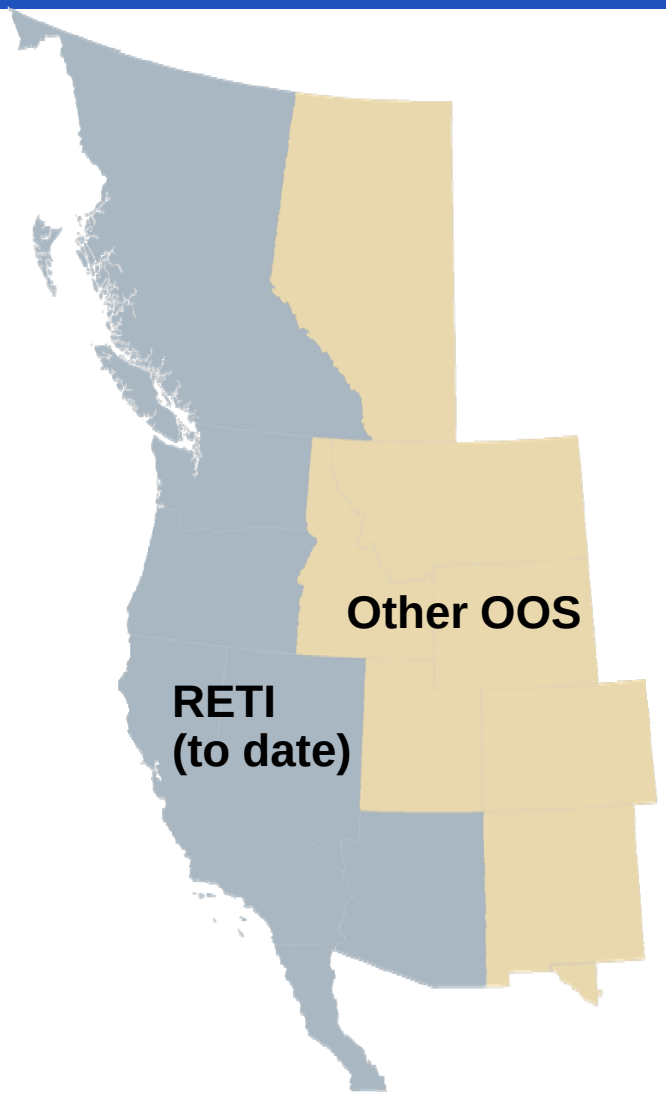
- Biomass
  - \+ 30% ITC vs $10/MWh PTC
  - \+ 85% vs. 80% Capacity factor
  - \+ ~10% reduction in capital cost
  - \- ~10% increase in O&M costs
- Wind
  - \+ 30% ITC vs $21/MWh PTC
  - \+ max capacity factor increased by 2% due to consideration of OOS wind
  - \+ $100/kW reduction in capital cost
- Geothermal
  - \+ 30% ITC vs $21/MWh PTC
  - \- Upper end of capital cost range increased to accommodate new smaller OOS plants
- Solar PV
  - \+ Substantial drop in capital cost and consideration of thin film as part of base case
- Solar Thermal
  - \- Increase in capital cost and decreased capacity factor due to assumption of dry cooling

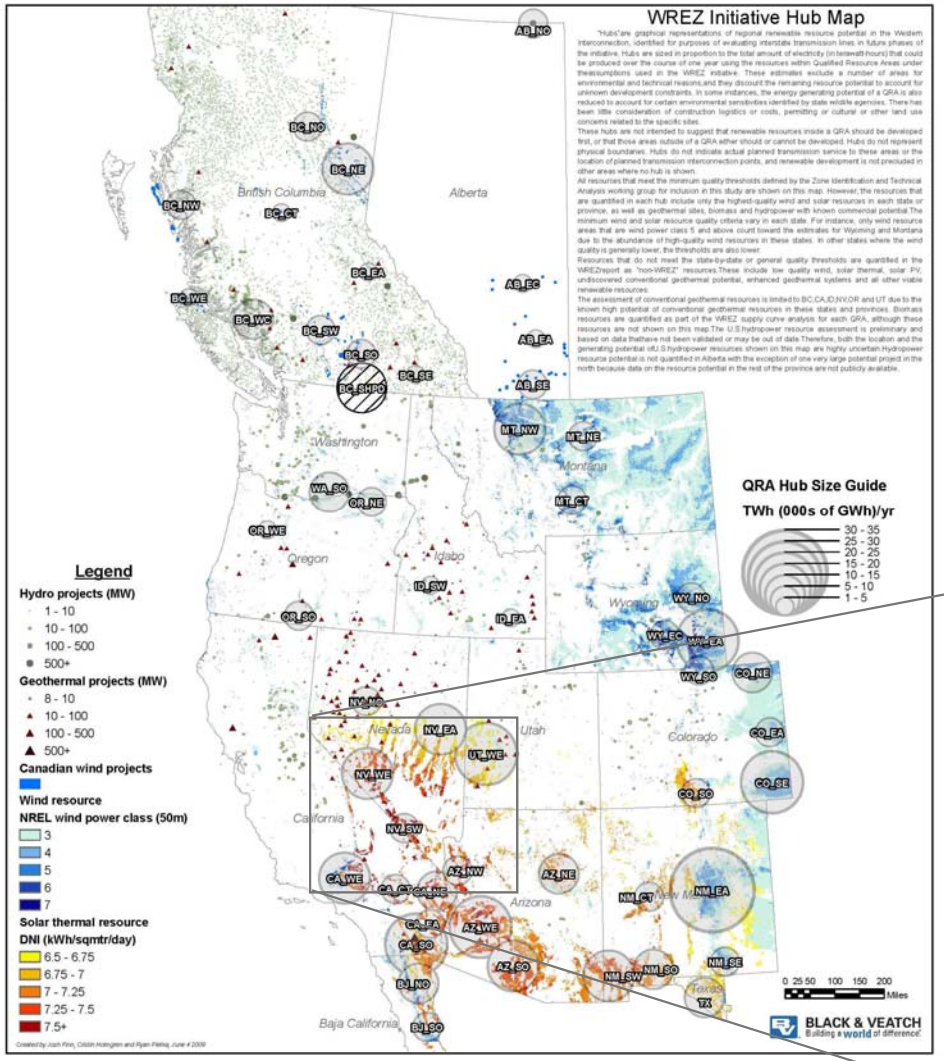
Out-of-State Update

Out-of-state (OOS) Update

1. Update estimates for current RETI OOS regions
2. Screen resources from additional OOS areas
3. Calculate delivered cost to California

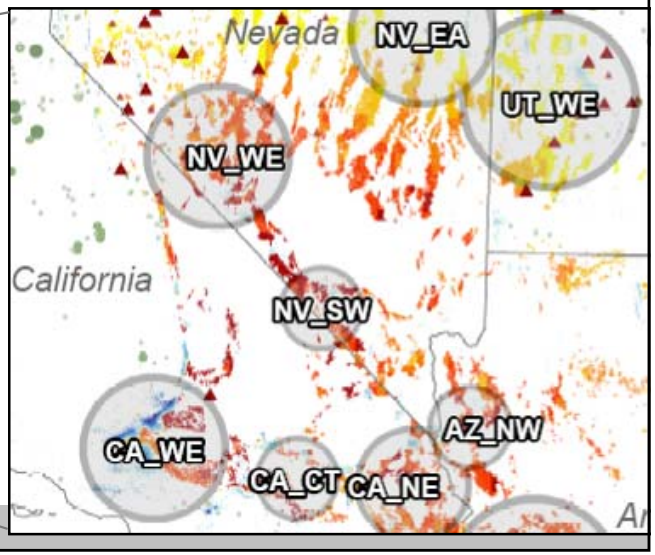
Use WREZ data to facilitate this





WREZ Resource Assessment

- Estimates resource potential at a particular price point in each “hub”



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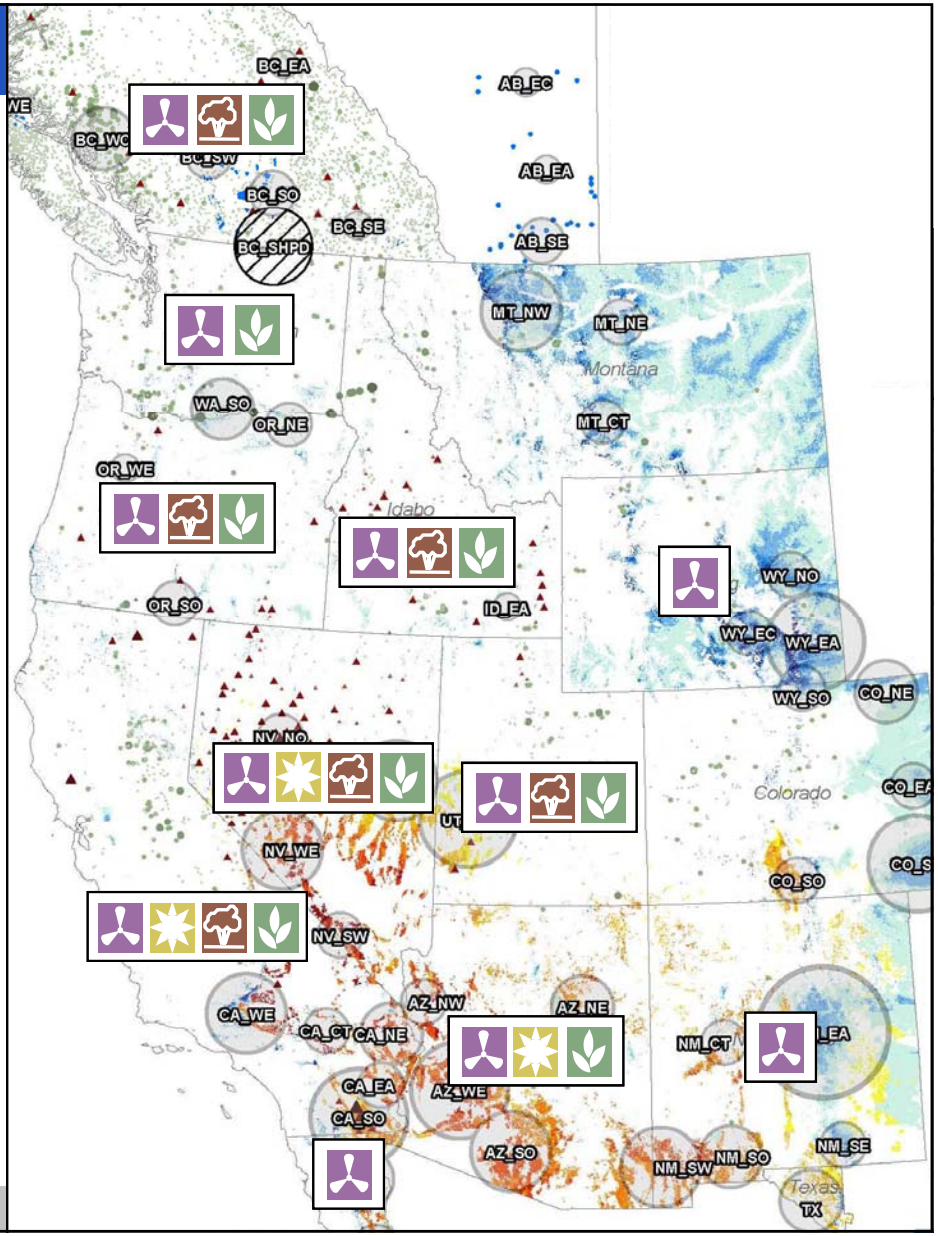
Initial Screening Identified Resources Considered in RETI Phase 2A Update

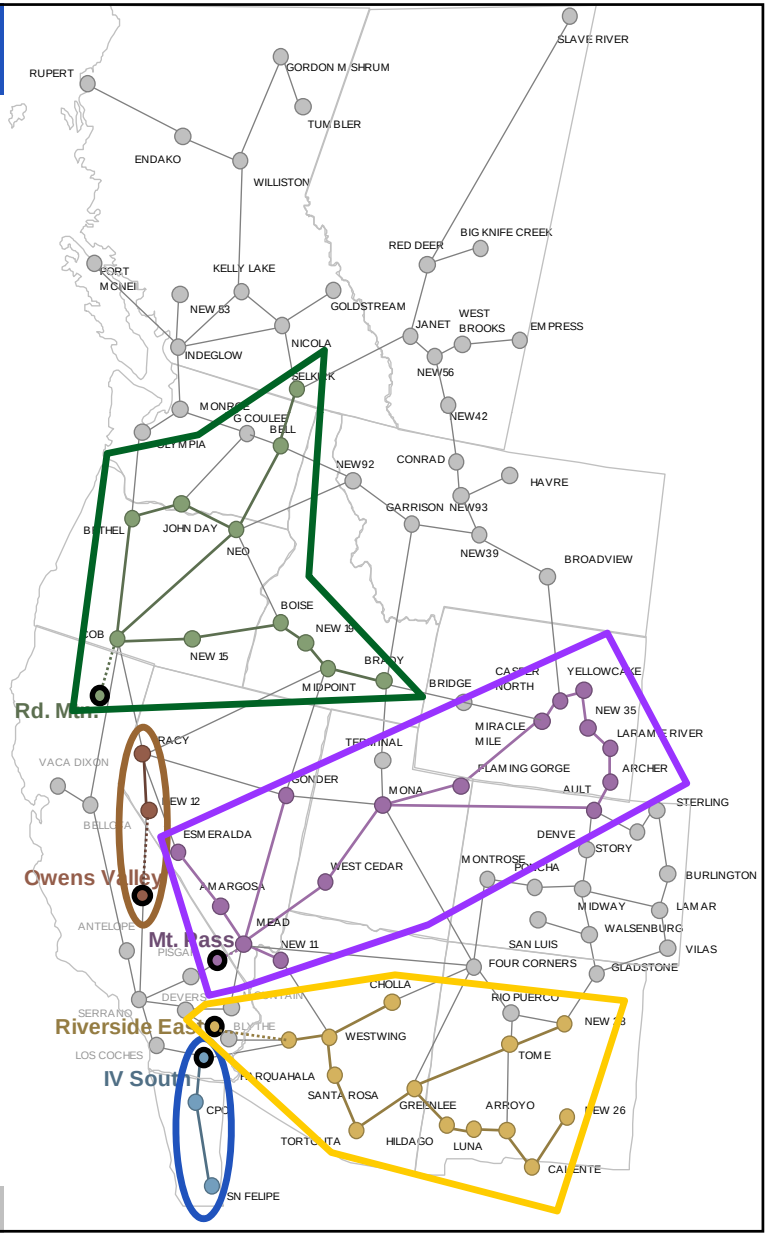


Transmission Cost Approach

- Out-of-state resources
  - 500 kV single-circuit ac transmission, 1500 MW capacity, $1.8 million/mile, federally financed, delivered to "gateway CREZs" (e.g., Mountain Pass)
    - From WREZ Transmission Characteristics Working Group
    - Line utilization based on region-specific factors
- In-state transmission costs:
  - Include all costs for 2A Collector Lines; allocation based on 2A shift factors
  - Include 50% of the 2A Foundation and Delivery Line costs; allocation based on 2A shift factors
  - Use 2A costs, annualized with 10% fixed charge rate

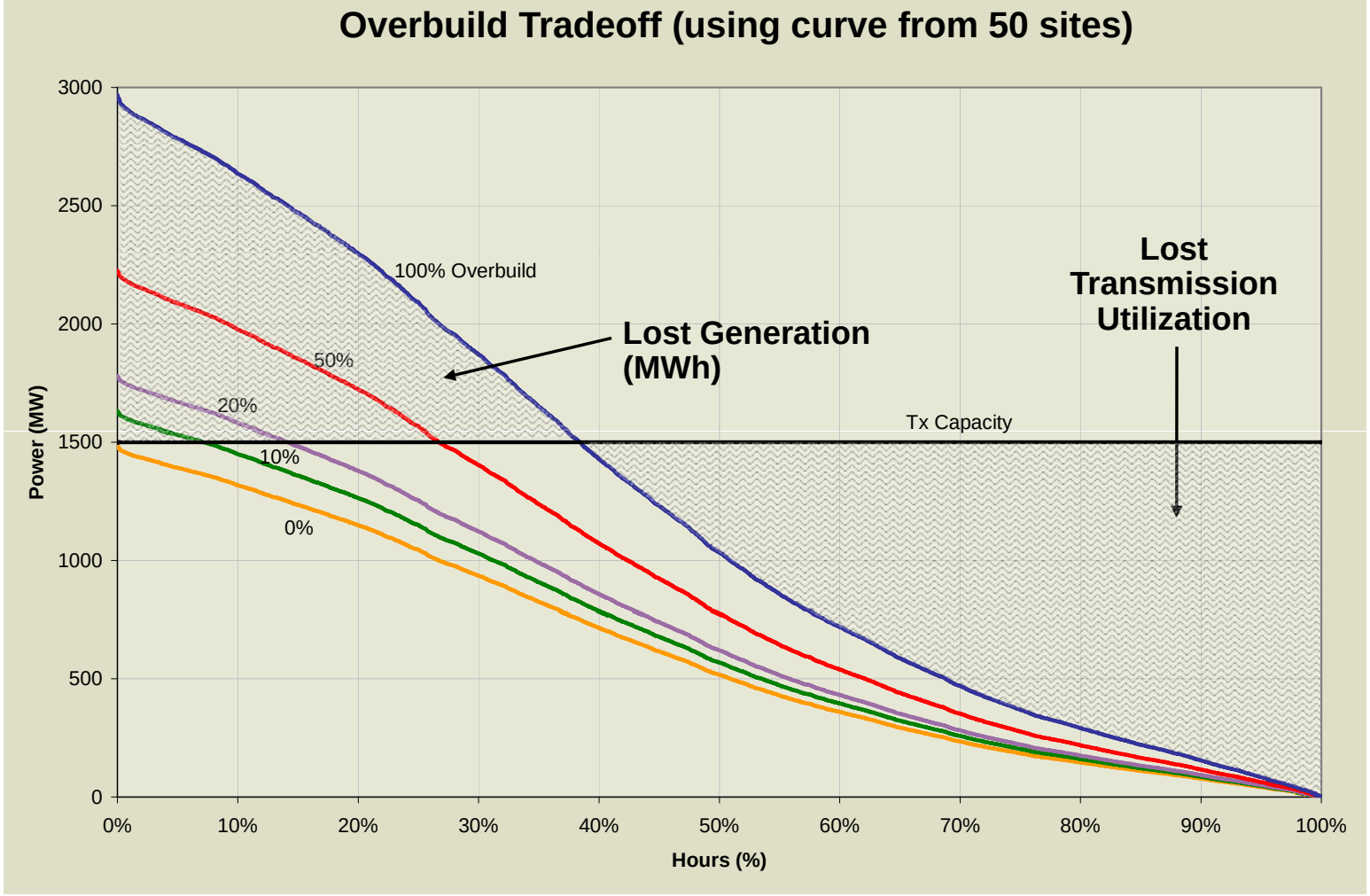
OOS Resources Delivered to California Gateway Substations / CREZs

- Pacific Northwest > Round Mountain
- Northern & Central Nevada > Owens Valley
- Southern Nevada, Utah and Wyoming > Mt. Pass
- Arizona, New Mexico > Riverside East
- Baja California > Imperial Valley South

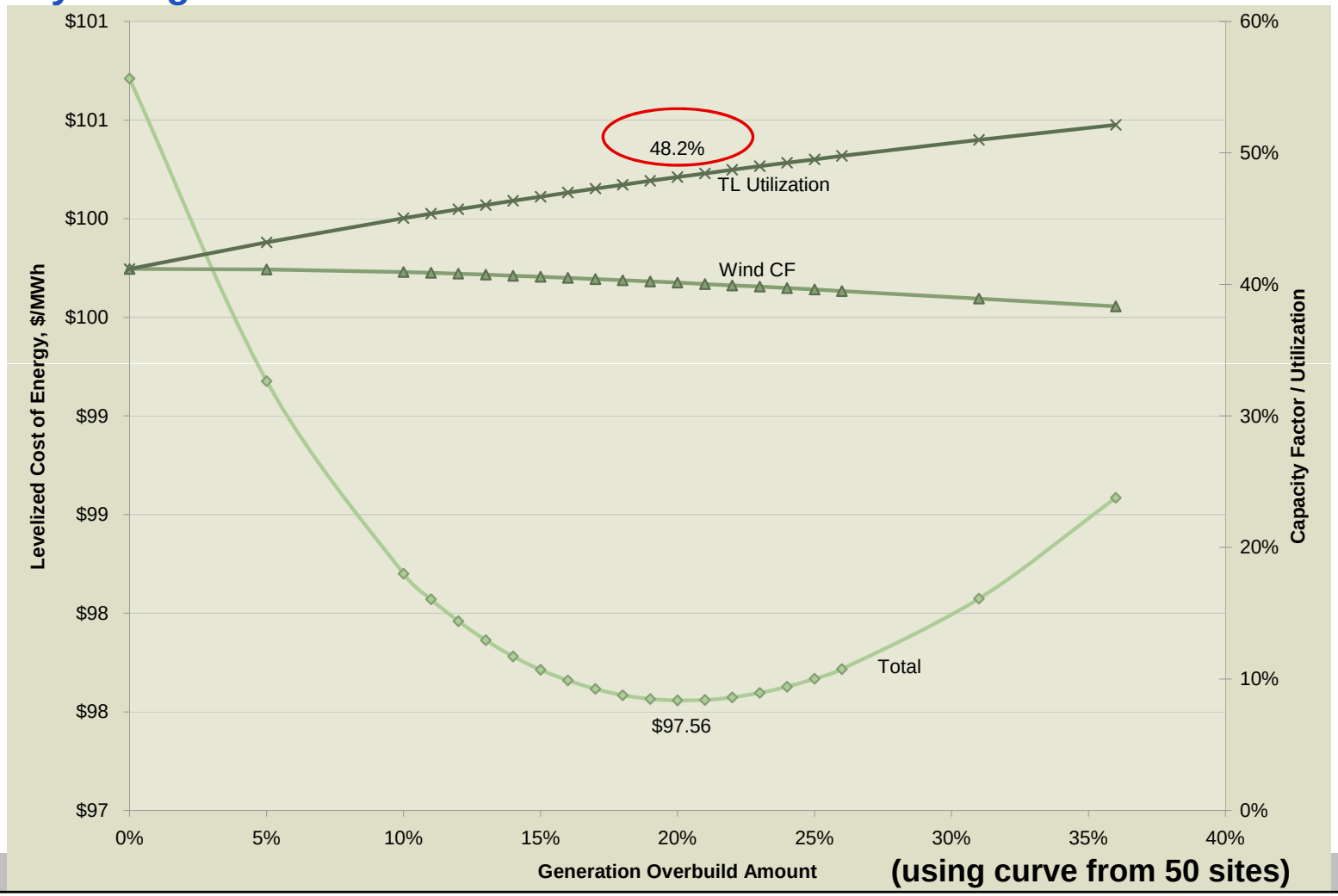


Transmission Line Utilization: Overbuild Tradeoff

- As generation is overbuilt relative to transmission line capacity:
  - Generation capacity factor decreases – generation cost increases
  - Transmission line utilization increases – transmission cost decreases
  - Optimum amount of overbuild can be determined


Overbuild Tradeoff (using curve from 50 sites)
Power (MW)
3000
2500
2000
1500
1000
500
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Hours (%)
100% Overbuild
50%
20%
10%
0%
Lost Generation (MWh)
Tx Capacity
Lost Transmission Utilization

Transmission Utilization at Optimal Overbuild (Cost-based)
Wyoming Wind



In Addition to Cost, should also Consider Effect on Value

Rank Cost = Adjusted Delivered Cost =
Generation Cost + Transmission Cost –
Energy Value – Capacity Value

Wyoming Wind

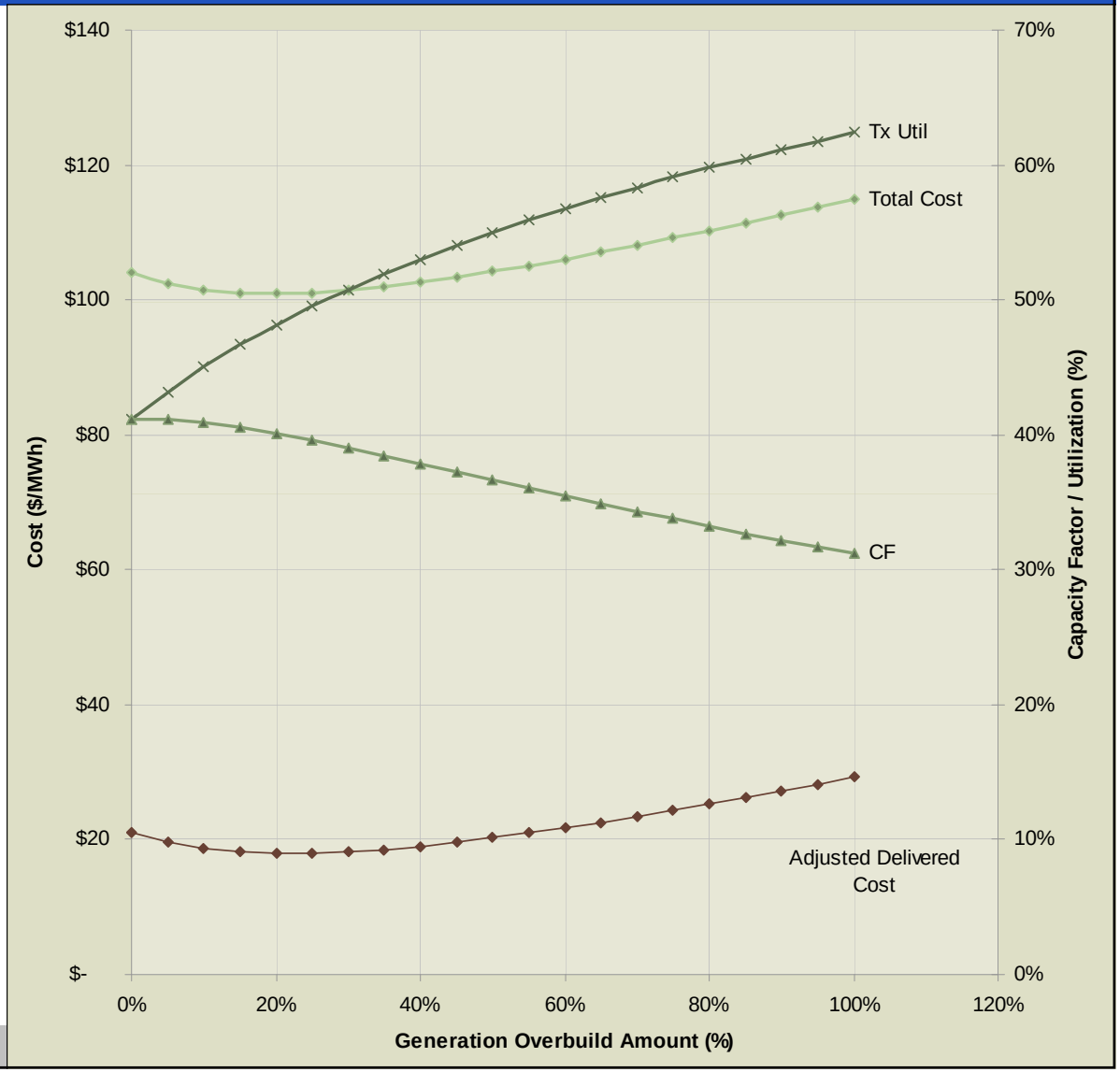
Optimum

Overbuild: 20%

LCOE: $100.92

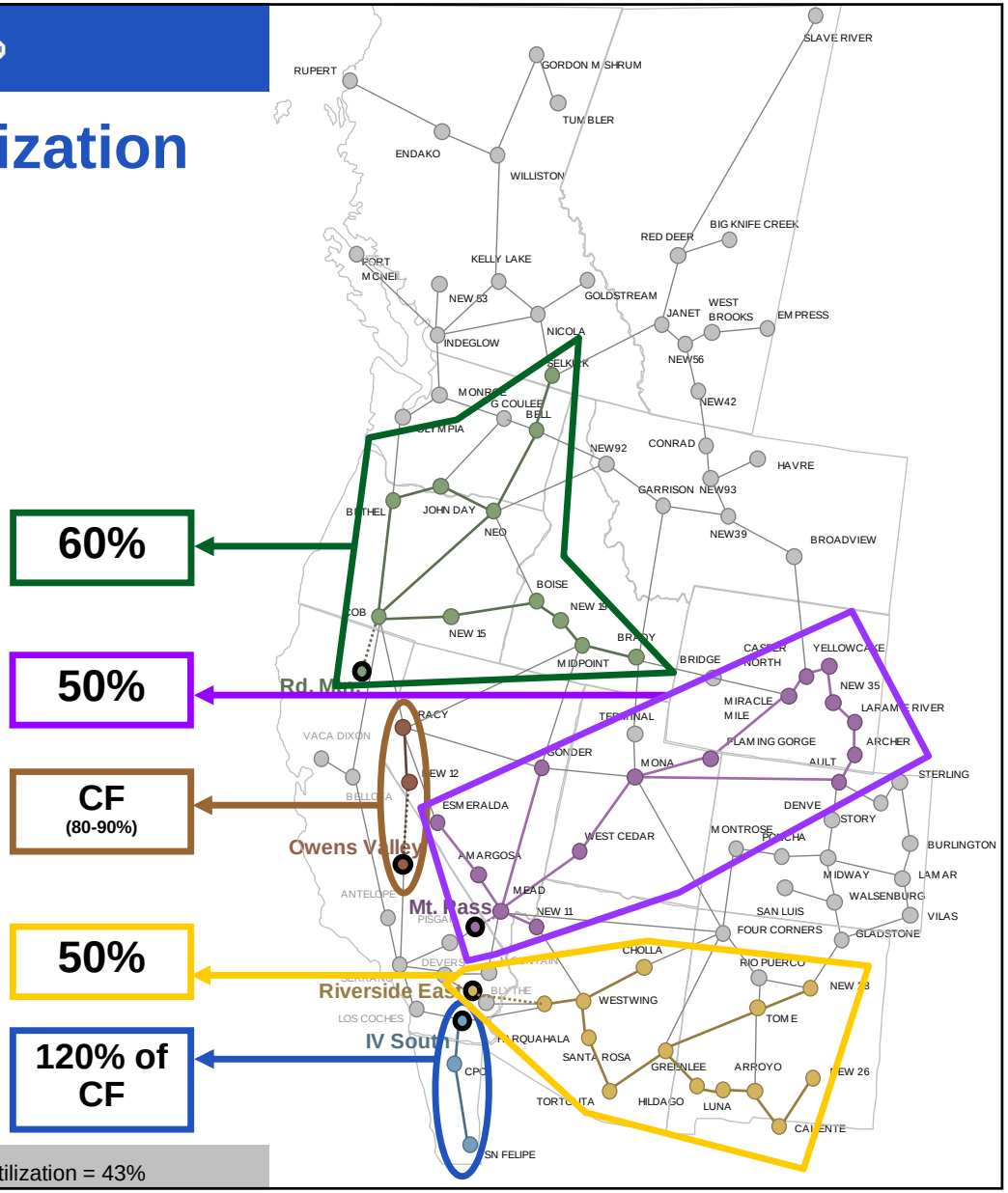
Adjusted Cost: $17.88

Tx Utilization: 48.2%



Transmission Utilization

- **Pacific Northwest** has lots of existing transfer, blend of resources (including hydro, biomass, geothermal, wind) → use 60%
- **N. Nevada** is largely geothermal → use resource CF (80-90%)
- **WY/UT/S. NV** – additional study has shown overbuild is economic, use 50%
- **AZ/NM** – Mixed wind and solar; additional study has shown overbuild is economic, use 50%
- **Baja** is all wind → use + 120% of resource CF to account for overbuild and dynamic line ratings*



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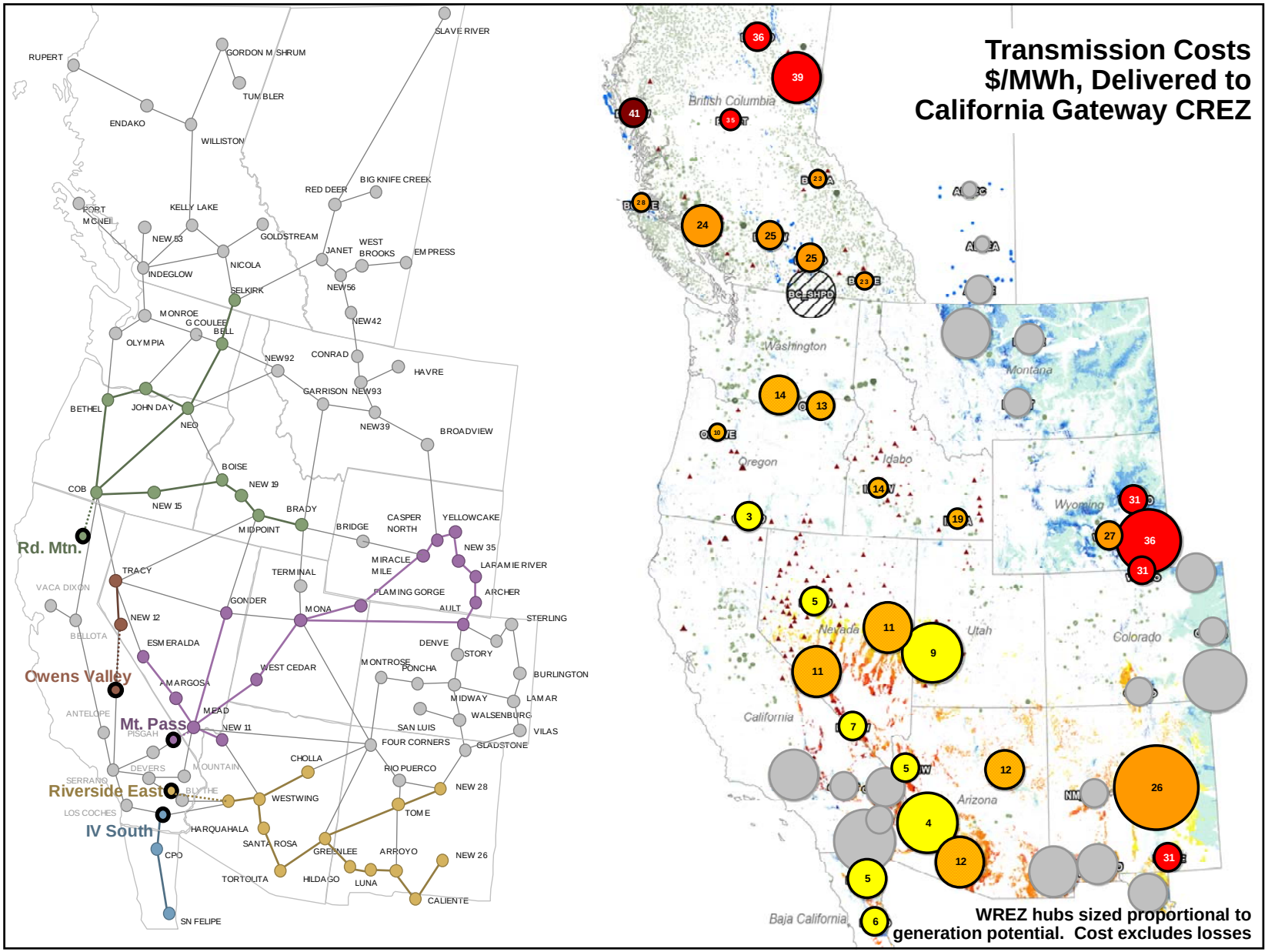
*Avg. Baja CF = 36%, avg. utilization = 43%


Transmission Costs
$/MWh, Delivered to
California Gateway CREZ
WREZ hubs sized proportional to
generation potential. Cost excludes losses
SLAVE RIVER
RUPERT
GORDON M SHRUM
TUMBLER
ENDAKO
WILLISTON
RED DEER
BIG KNIFE CREEK
FORT MCNEIL
KELLY LAKE
NEW 53
GOLDSTREAM
JANET
WEST BROOKS
EMPRESS
INDEGLOW
NICOLA
NEW56
SELKIRK
NEW42
MONROE
G COULEE
BELL
OLYMPIA
NEW92
CONRAD
HAVRE
GARRISON
NEW93
BETHEL
JOHN DAY
NEO
NEW39
BROADVIEW
BOISE
COB
NEW 19
NEW 15
BRADY
MIDPOINT
BRIDGE
CASPER NORTH
YELLOWCAKE
Rd. Mtn.
NEW 35
MIRACLE MILE
LARAMIE RIVER
TRACY
TERMINAL
VACA DIXON
FLAMING GORGE
ARCHER
GONDER
MONA
AULT
STERLING
NEW 12
BELLOTA
ESMERALDA
DENVE
STORY
MONTROSE
PONCHA
WEST CEDAR
Owens Valley
AMARGOSA
BURLINGTON
MIDWAY
LAMAR
ANTELOPE
MEAD
Mt. Pass
NEW 11
WALSENBURG
SAN LUIS
VILAS
PISGAH
FOUR CORNERS
GLADSTONE
CHOLLA
DEVERS
MOUNTAIN
RIO PUERCO
SERRANO
Riverside East
BLYTHE
NEW 28
WESTWING
LOS COCHES
TOME
IV South
HARQUAHALA
SANTA ROSA
GREENLEE
ARROYO
NEW 26
CPO
TORTOLITA
HILDAGO
LUNA
CALIENTE
SN FELIPE
British Columbia
Washington
Oregon
Idaho
Montana
Wyoming
Nevada
Utah
Colorado
California
Arizona
Baja California
BC_SHPD
36
39
41
35
23
28
24
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25
23
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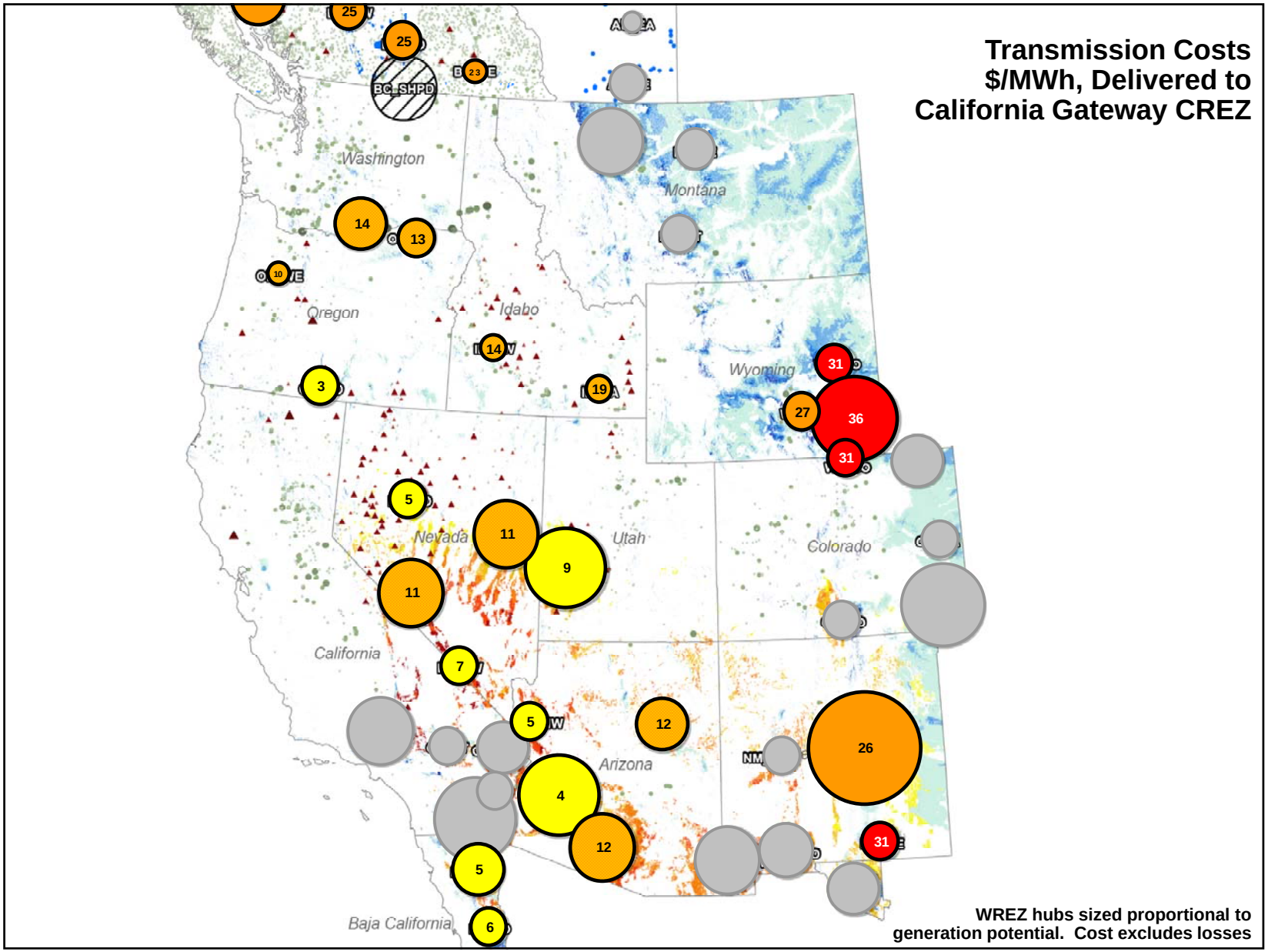

Transmission Costs
$/MWh, Delivered to
California Gateway CREZ
Washington
Montana
Oregon
Idaho
Wyoming
Nevada
Utah
Colorado
California
Arizona
Baja California
BC_SHPD
25
25
14
13
10
14
3
19
31
27
36
31
5
11
9
11
7
5
12
26
4
12
31
5
6
WREZ hubs sized proportional to
generation potential. Cost excludes losses

Summary of Recommended Resource Assessments to Use (RETI vs. WREZ) MW Estimates

Discussing Potential Update with BC

	CA	OR	WA	NV	AZ	Baja	BC
Bio	1,725 147	454 646	449 101	 300	 327		1,520 939
PV	27,460			 18,582	 19,780		
ST	65,200 16,069			7,429 18,582	7,129 19,780		
Wind	16,208 6,042	4,688 2,897	3,762 3,260	1,475 431	 3,717	5,000 2,937	2,405 13,943
Geo	1,918 1,434	520 832		1,283 1,408			244 340

CA values to be replaced with updated 2A

New assessments performed

Notes: PV and ST not differentiated in WREZ, assumed all ST

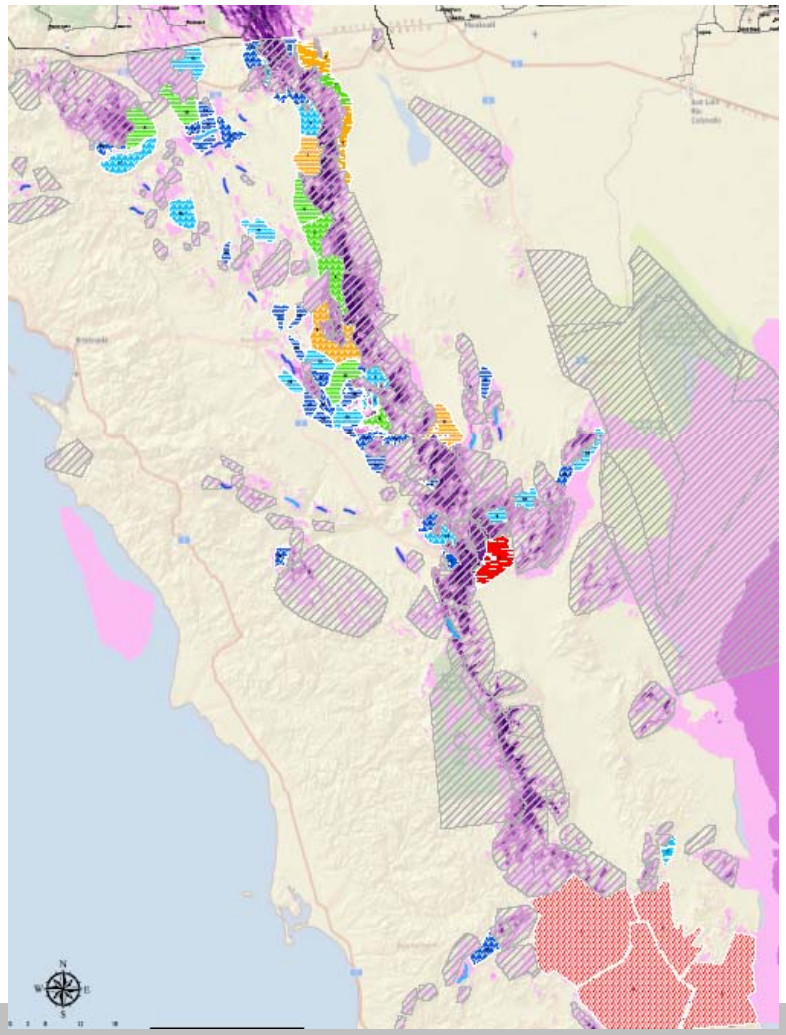
Updated Estimates Performed for Some Regions

- Nevada geothermal – New BLM leases
- Nevada wind – consideration of northern resources
- Baja California wind

RETI: Baja Wind Energy Assessment

Results

- 33,285 MW of technical potential
- Quantified 8,305 MW as developable potential (25% of technical)
- 89 projects
- Average capacity factor: 35%
- Average capital cost: $2,450 / kW

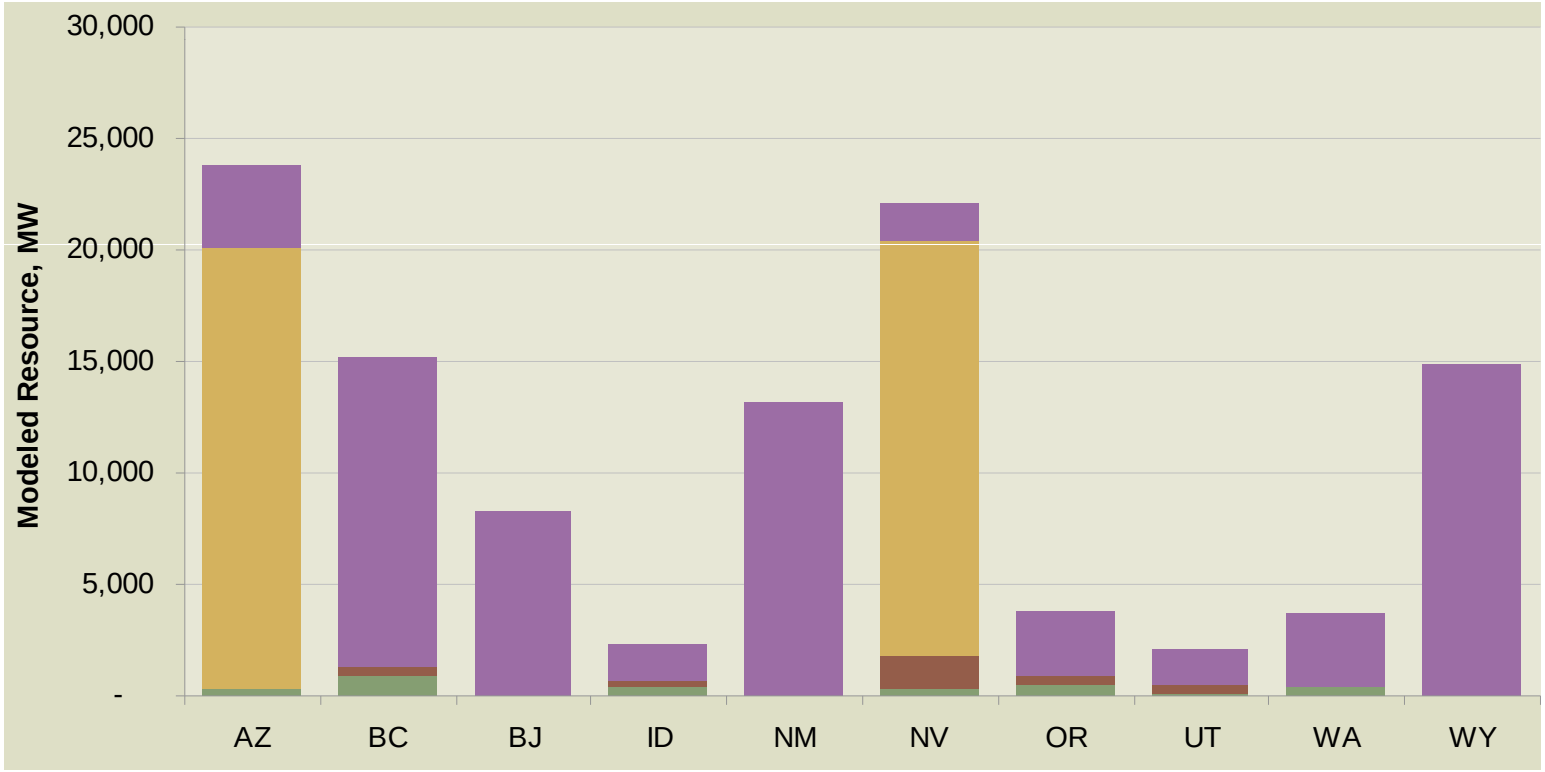


Final Recommendations for Out-of-State Resource Estimates (MW)

State	Biomass	Geothermal	Solar	Wind	Total
AZ	329		19,782	3,714	23,825
BC	939	340		13,942	15,221
BJ				8,305	8,305
ID	358	329		1,649	2,336
NM				13,186	13,186
NV	299	1,467	18,588	1,754	22,107
OR	454	403		2,913	3,770
UT	90	375		1,679	2,144
WA	449			3,262	3,711
WY				14,853	14,853
Total	2,918	2,914	38,370	65,257	109,459

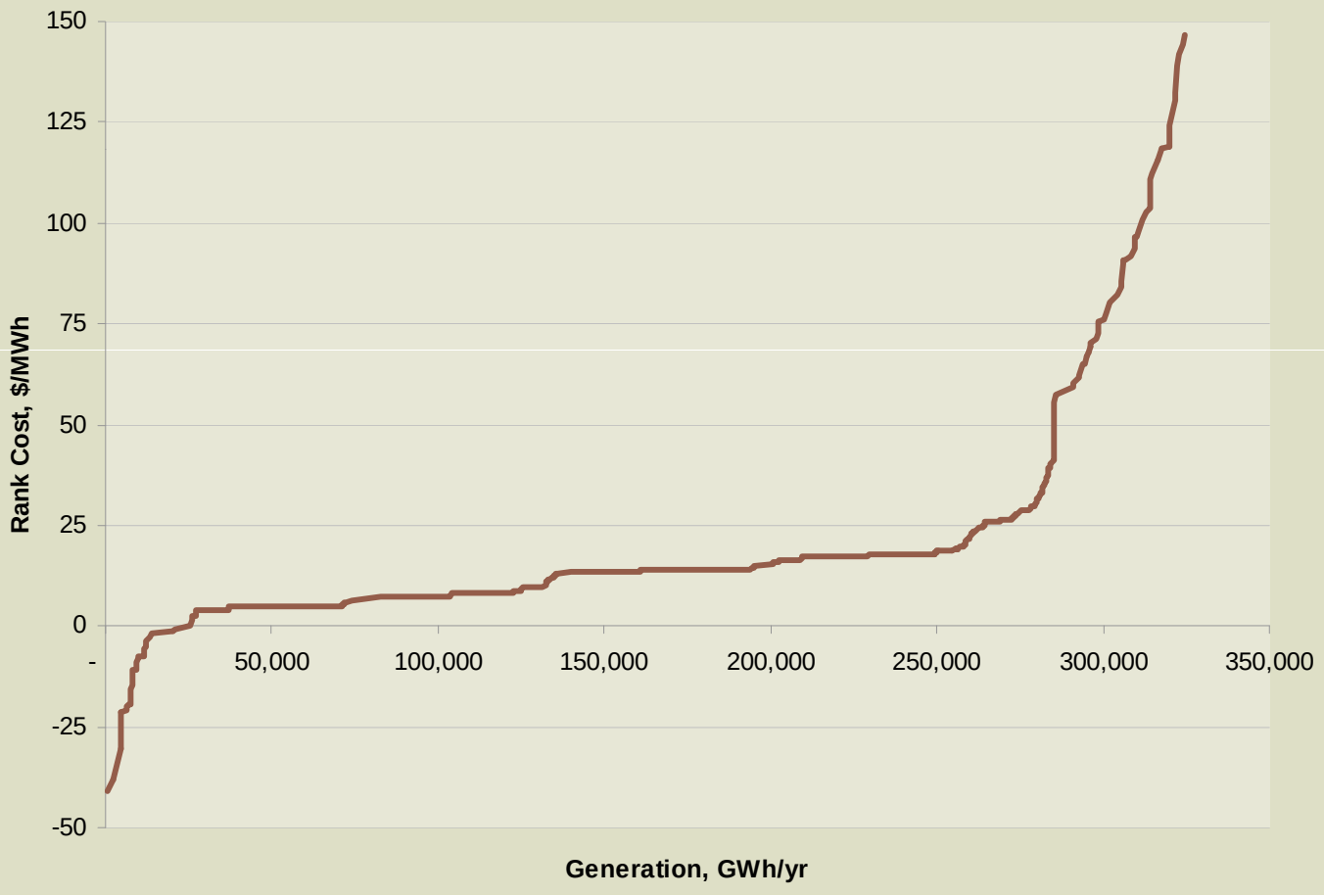
Notes: Oregon geothermal in WREZ includes northern California resources. Removed to prevent double counting. Removed NV geothermal already under contract to NV Energy. Solar estimate is for either PV or solar thermal

Final Recommendations for Out-of-State Resource Estimates (MW)

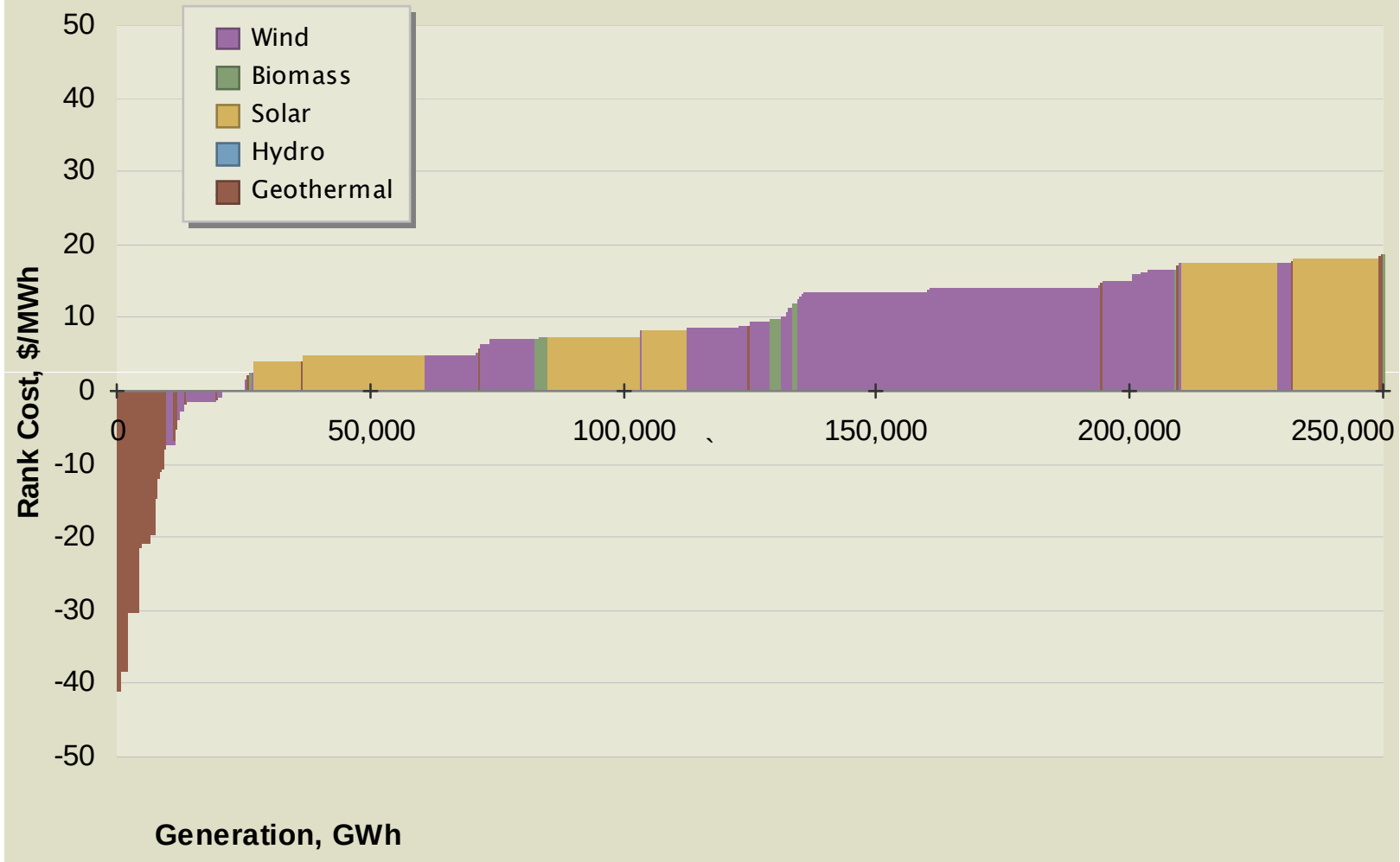


Out-of-State Supply Curve

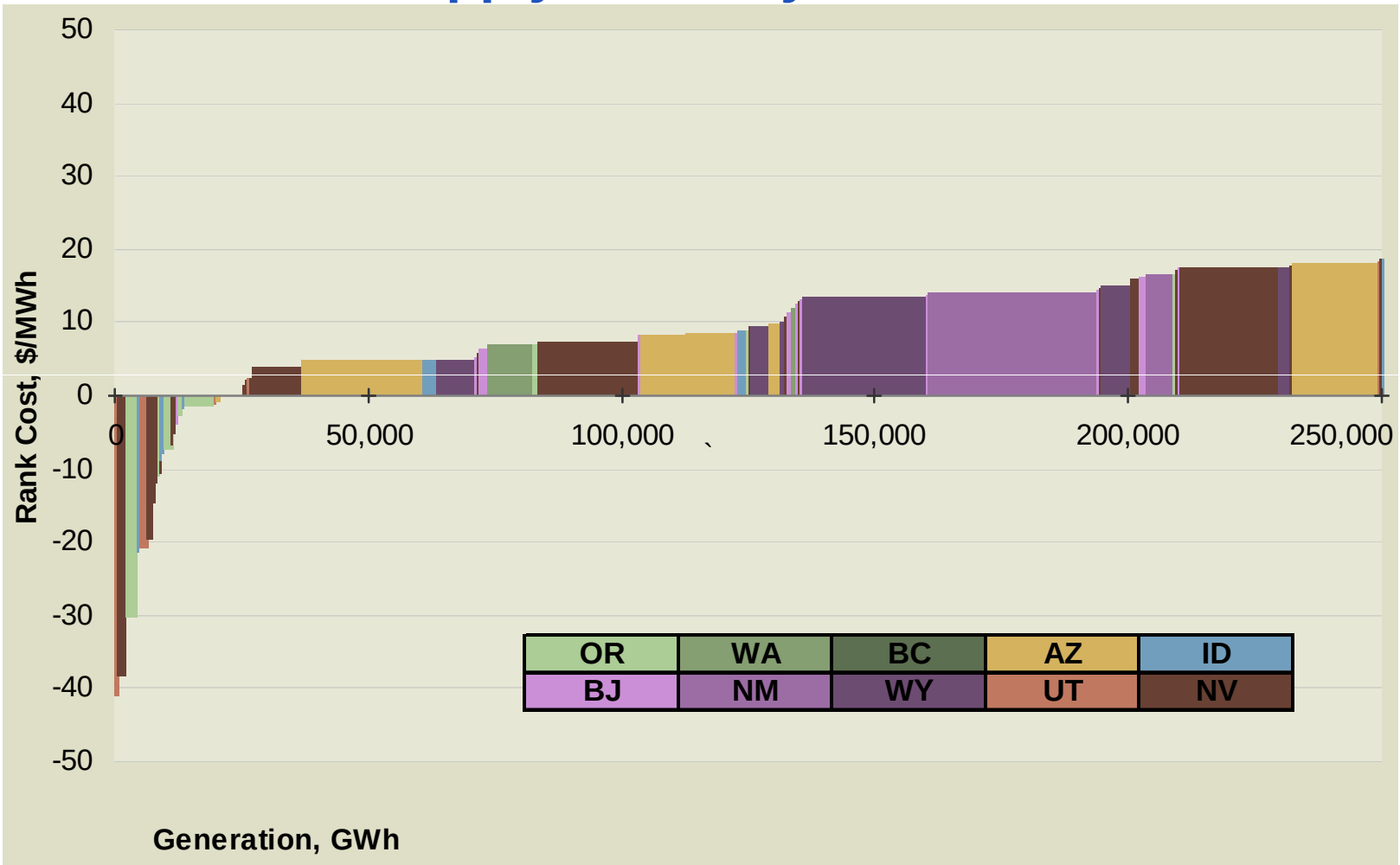
Rank Cost, $/MWh – Delivered to California Gateway CREZs



Out-of-State Supply Curve by Technology



Out-of-State Supply Curve by State



California CREZ Updates

CREZ Refinement
California Desert Protection Act of 2010

Capacity (MW) Estimates from Phase 2A

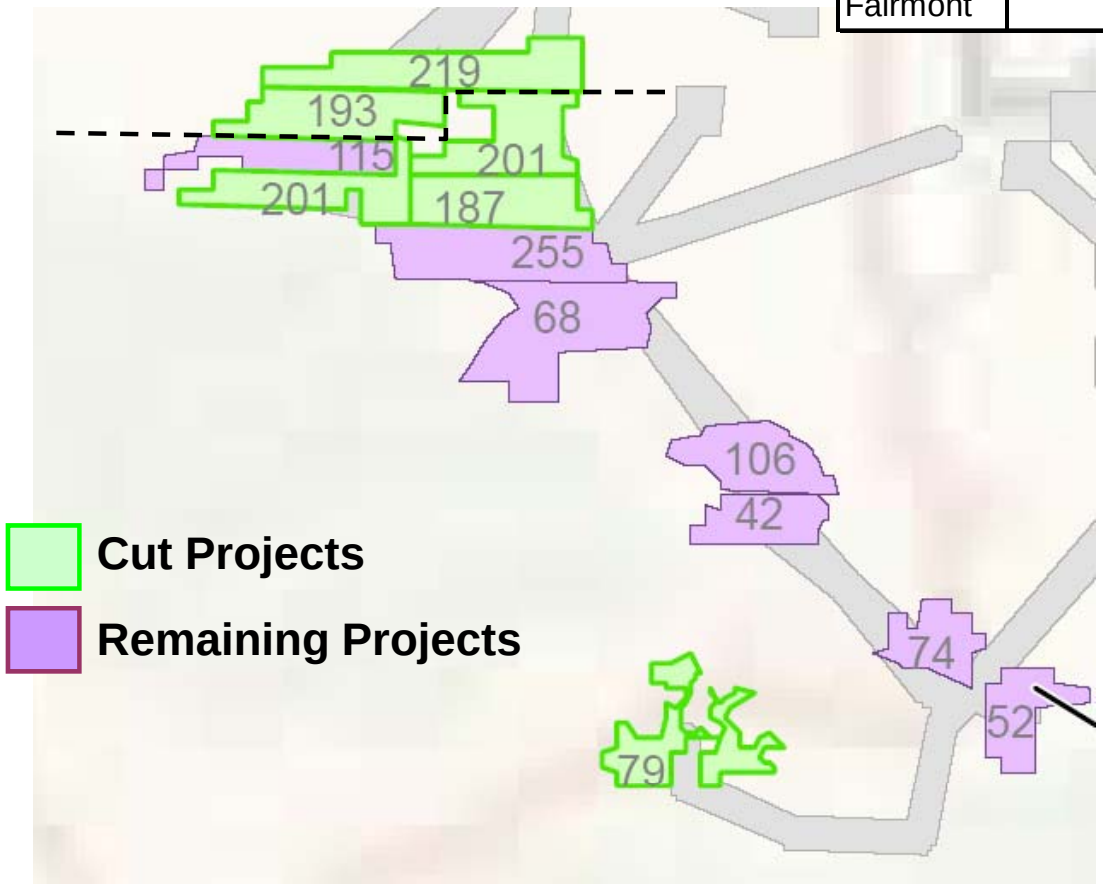
	Phase 1B to Phase 2A		
CREZ	**Phase 1B**	**Phase 2A**	**Change**
Barstow	2,136	2,336	200
Carrizo North	1,600	1,600	0
Carrizo South	3,000	3,877	877
Cuyama	400	800	400
Fairmont	6,918	3,518	-3,400
Imperial East	1,723	1,623	-100
Imperial North-A	1,370	1,370	0
Imperial North-B	1,830	1,830	0
Imperial South	3,745	3,715	-30
Inyokern	2,887	2,432	-455
Iron Mountain	5,662	4,912	-750
Kramer	6,627	6,412	-215
Lassen North-A	821	1,467	646
Lassen North-B	2,001	0	-2,001
Lassen South-A	410	410	0
Lassen South-B	1,200	0	-1,200
Mountain Pass	2,878	1,658	-1,220
Needles	1,061	461	-600
Owens Valley	1,400	1,400	0
Palm Springs	770	770	0
Pisgah-A	1,800	2,550	750
Pisgah-B	3,790	0	-3,790
Riverside East-A	1,000	10,550	9,550
Riverside East-B	6,800	0	-6,800
Round Mountain-A	240	384	144
Round Mountain-B	187	187	0
San Bernardino - Baker	1,200	3,670	2,470
San Bernardino - Lucerne	4,290	3,030	-1,260
San Diego North Central	281	281	0
San Diego South	678	678	0
Santa Barbara	433	433	0
Solano	894	894	0
Tehachapi	9,642	10,837	1,195
Twentynine Palms	800	1,805	1,005
Victorville-A	800	1,636	836
Victorville-B	895	0	-895
Victorville-C	340	0	-340
Westlands	0	0	0
Total	**82,509**	**77,526**	**-4,983**

In-State California CREZ Updates from Phase 2A

- Fairmont / Tehachapi
- Palm Springs
- Owens Valley
- Westlands Water District

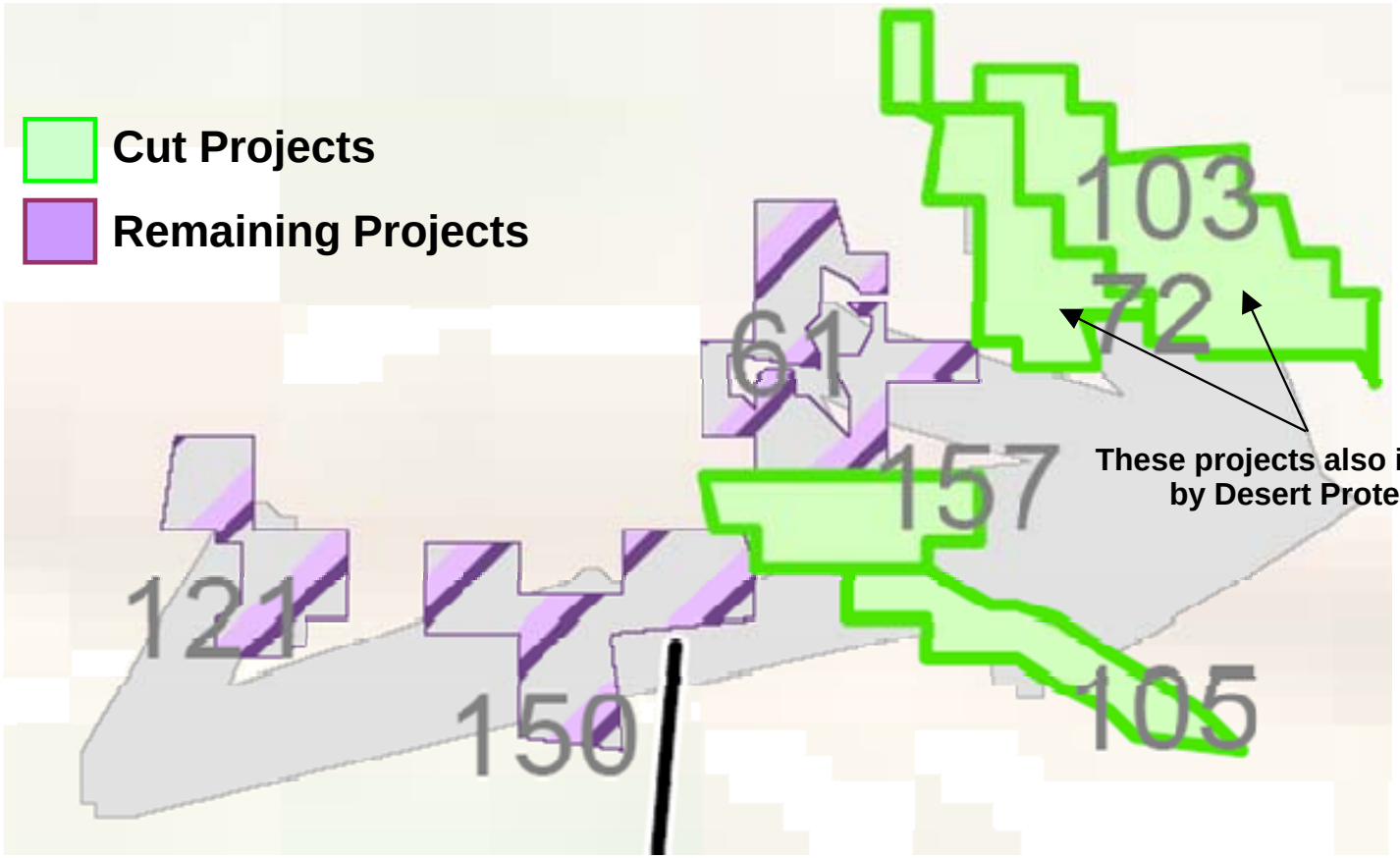
Fairmont / Tehachapi Wind

	Phase 2A	Current	Net Change
Tehachapi	10,837	10,425	-412
Fairmont	3,518	2,850	-668



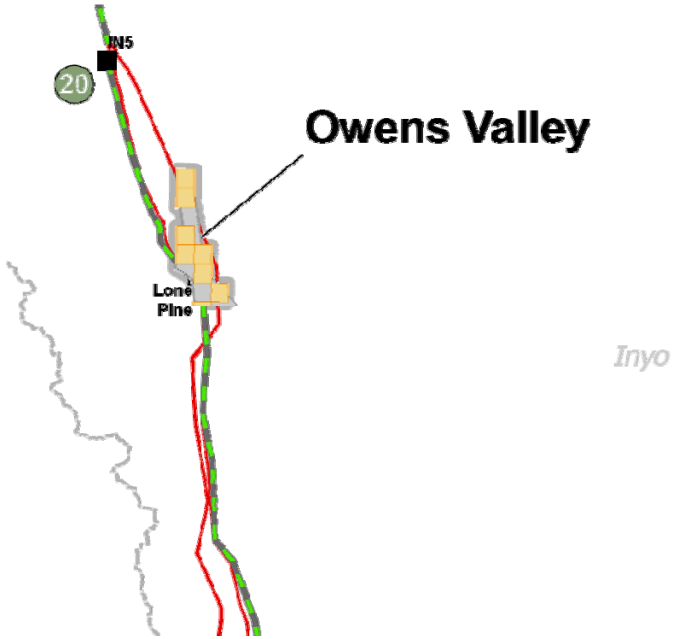
Palm Springs Wind

	Phase 2A	Current	Net Change
Palm Springs	770	333	-437

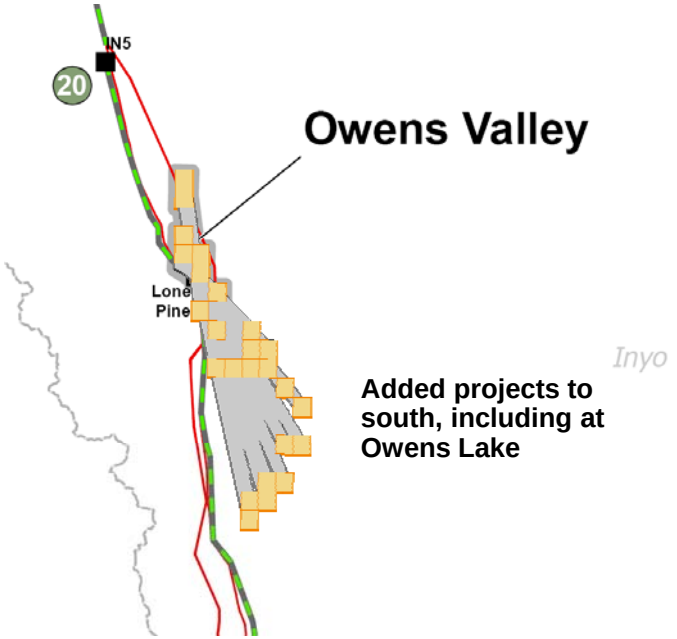


Owens Valley

	Phase 2A	Current	Net Change
Owens Valley	1400	5,000	3,600



Phase 2A

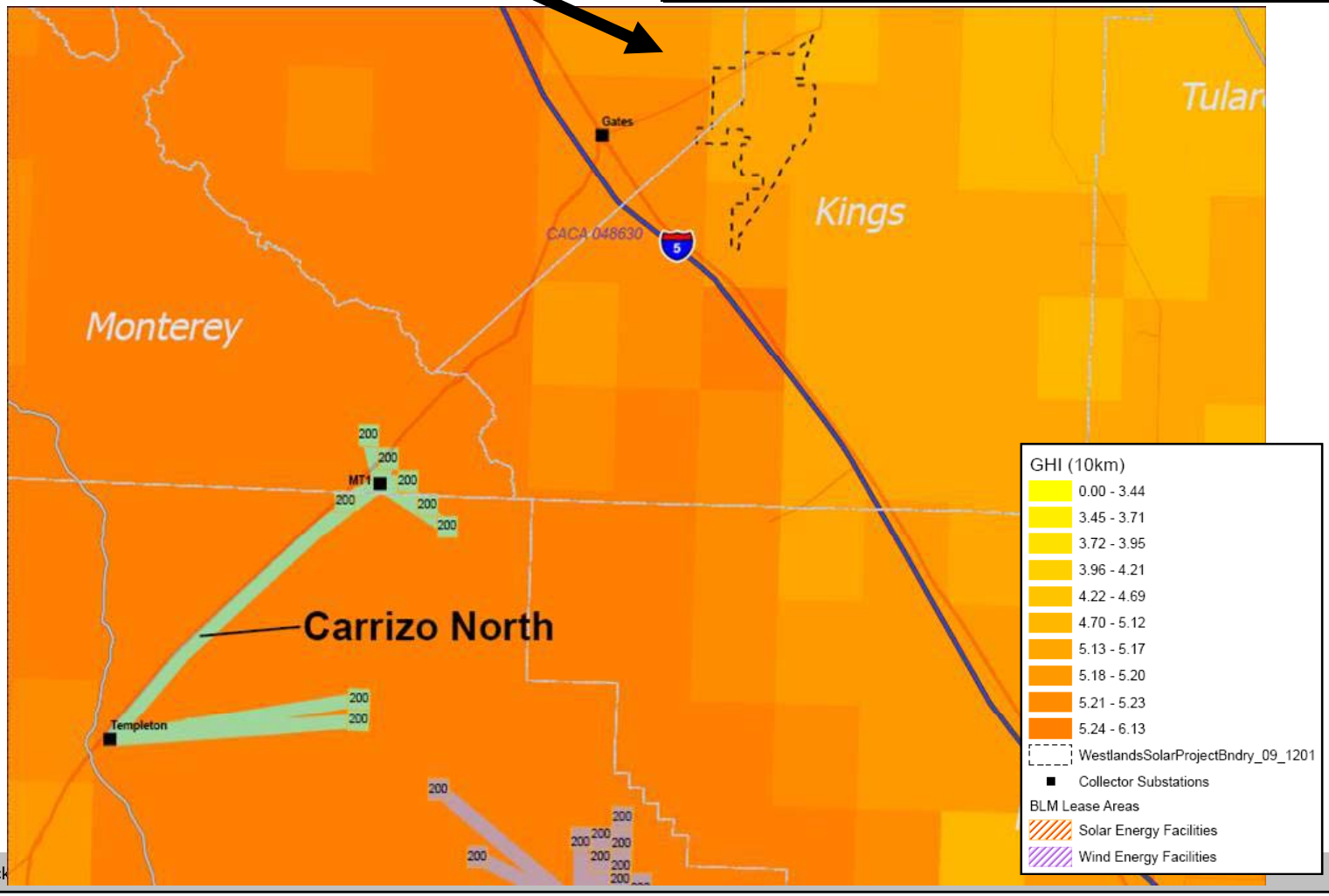


Added projects to south, including at Owens Lake

Current

Westlands Water District

	Phase 2A	Current	Net Change
Westlands	0	5,000	5,000



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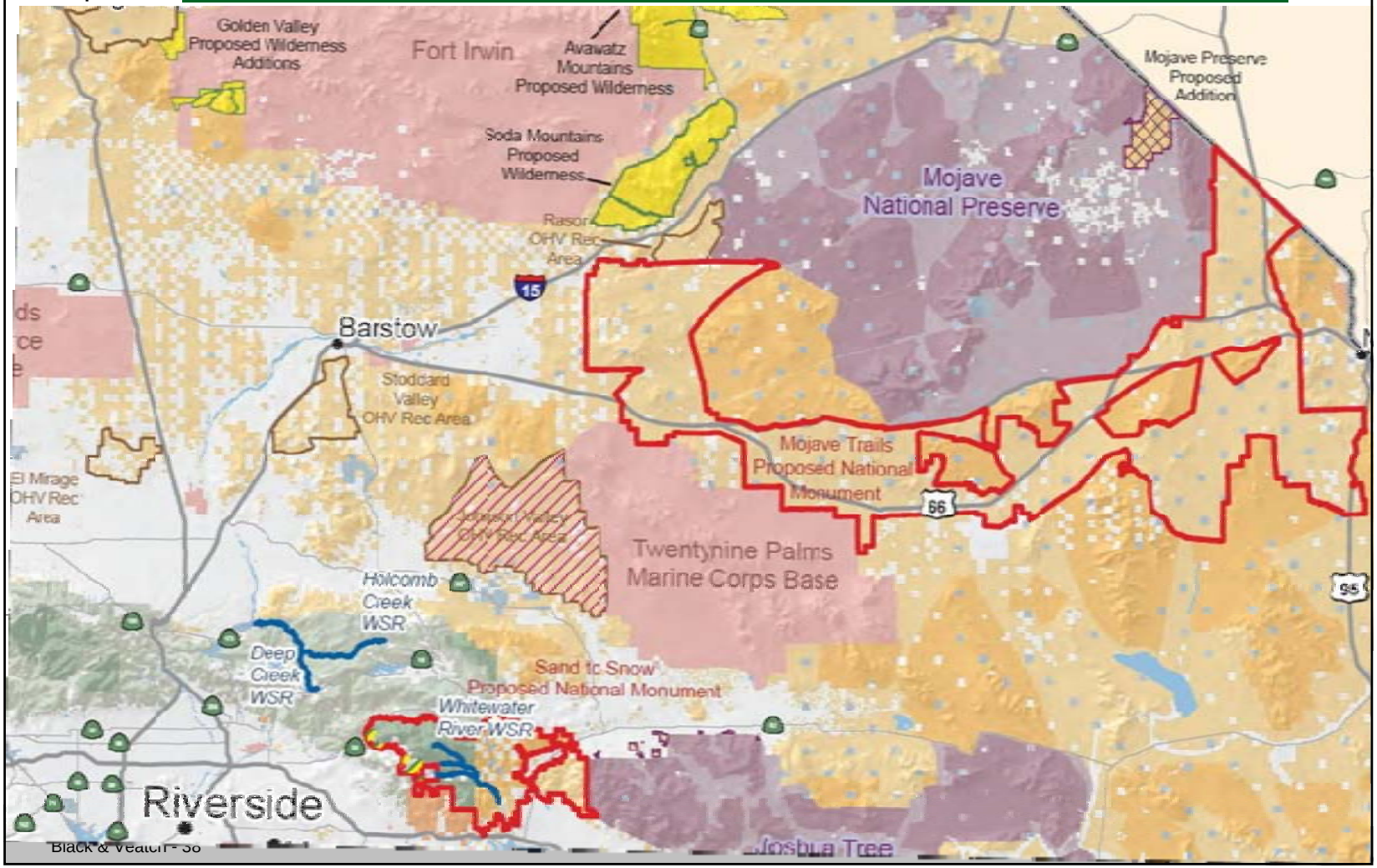
Capacity (MW) Estimates after CREZ Adjustments (Phase 2A Update)

	Phase 1B to Phase 2A			Phase 2A to Phase 2A Update	
CREZ	Phase 1B	Phase 2A	Change	2A Update	Change
Barstow	2,136	2,336	200	2,336	0
Carrizo North	1,600	1,600	0	1,600	0
Carrizo South	3,000	3,877	877	3,877	0
Cuyama	400	800	400	800	0
Fairmont	6,918	3,518	-3,400	2,850	-668
Imperial East	1,723	1,623	-100	1,623	0
Imperial North-A	1,370	1,370	0	1,370	0
Imperial North-B	1,830	1,830	0	1,830	0
Imperial South	3,745	3,715	-30	3,715	0
Inyokern	2,887	2,432	-455	2,432	0
Iron Mountain	5,662	4,912	-750	4,912	0
Kramer	6,627	6,412	-215	6,412	0
Lassen North-A	821	1,467	646	1,467	0
Lassen North-B	2,001	0	-2,001	0	0
Lassen South-A	410	410	0	410	0
Lassen South-B	1,200	0	-1,200	0	0
Mountain Pass	2,878	1,658	-1,220	1,658	0
Needles	1,061	461	-600	461	0
Owens Valley	1,400	1,400	0	5,000	3,600
Palm Springs	770	770	0	333	-437
Pisgah-A	1,800	2,550	750	2,550	0
Pisgah-B	3,790	0	-3,790	0	0
Riverside East-A	1,000	10,550	9,550	10,550	0
Riverside East-B	6,800	0	-6,800	0	0
Round Mountain-A	240	384	144	384	0
Round Mountain-B	187	187	0	187	0
San Bernardino - Baker	1,200	3,670	2,470	3,670	0
San Bernardino - Lucerne	4,290	3,030	-1,260	3,030	0
San Diego North Central	281	281	0	281	0
San Diego South	678	678	0	678	0
Santa Barbara	433	433	0	433	0
Solano	894	894	0	894	0
Tehachapi	9,642	10,837	1,195	10,425	-412
Twentynine Palms	800	1,805	1,005	1,805	0
Victorville-A	800	1,636	836	1,636	0
Victorville-B	895	0	-895	0	0
Victorville-C	340	0	-340	0	0
Westlands	0	0	0	5,000	5,000
Total	**82,509**	**77,526**	**-4,983**	**84,609**	**7,083**

Impacts of 2010 California Desert Protection Act

Map Source: http://feinstein.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=14d49cae-7398-4d7e-8693-40ed19b44299



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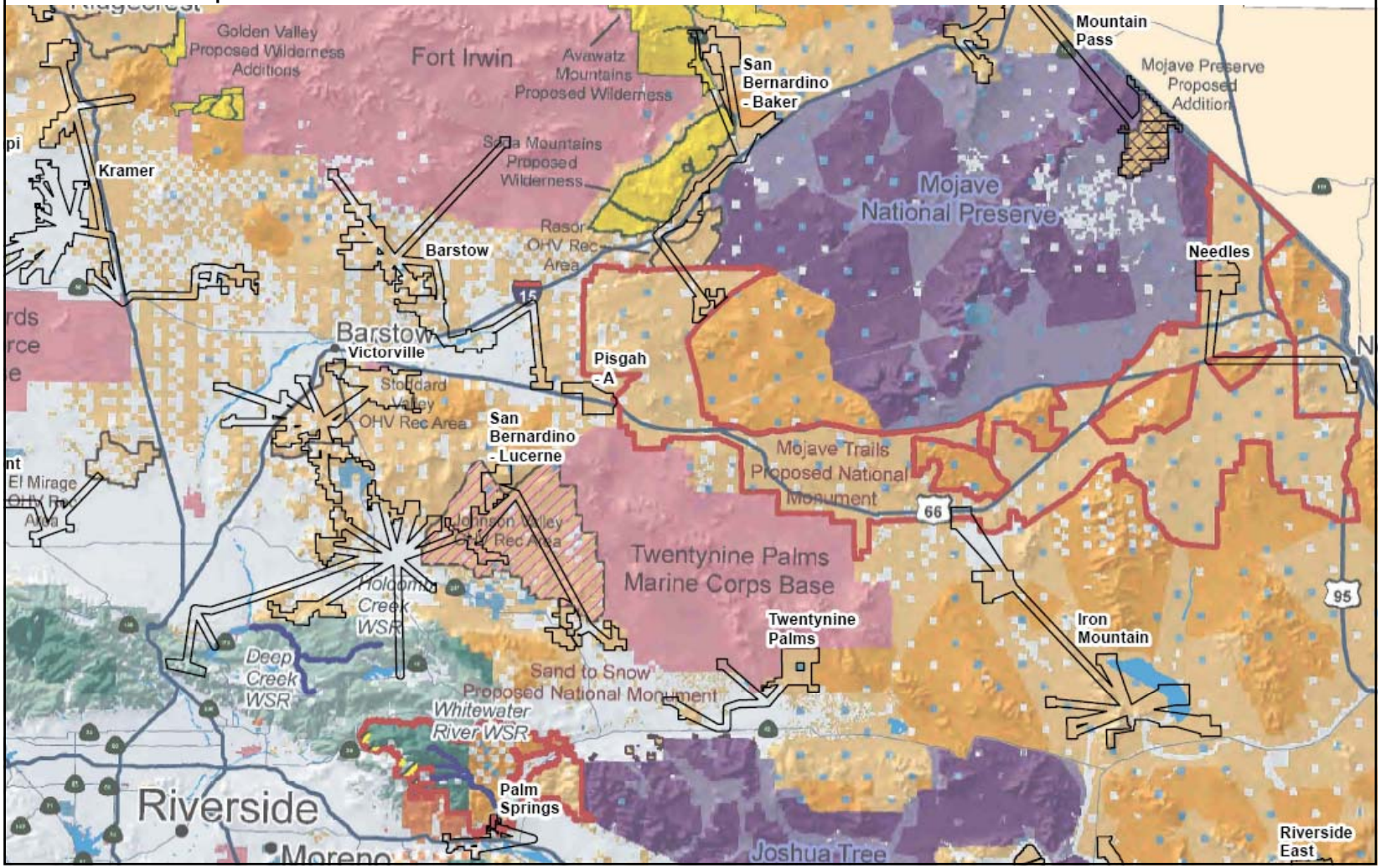
Impacts of 2010 California Desert Protection Act

CREZ boundaries per Black & Veatch – to be reconciled with CEC



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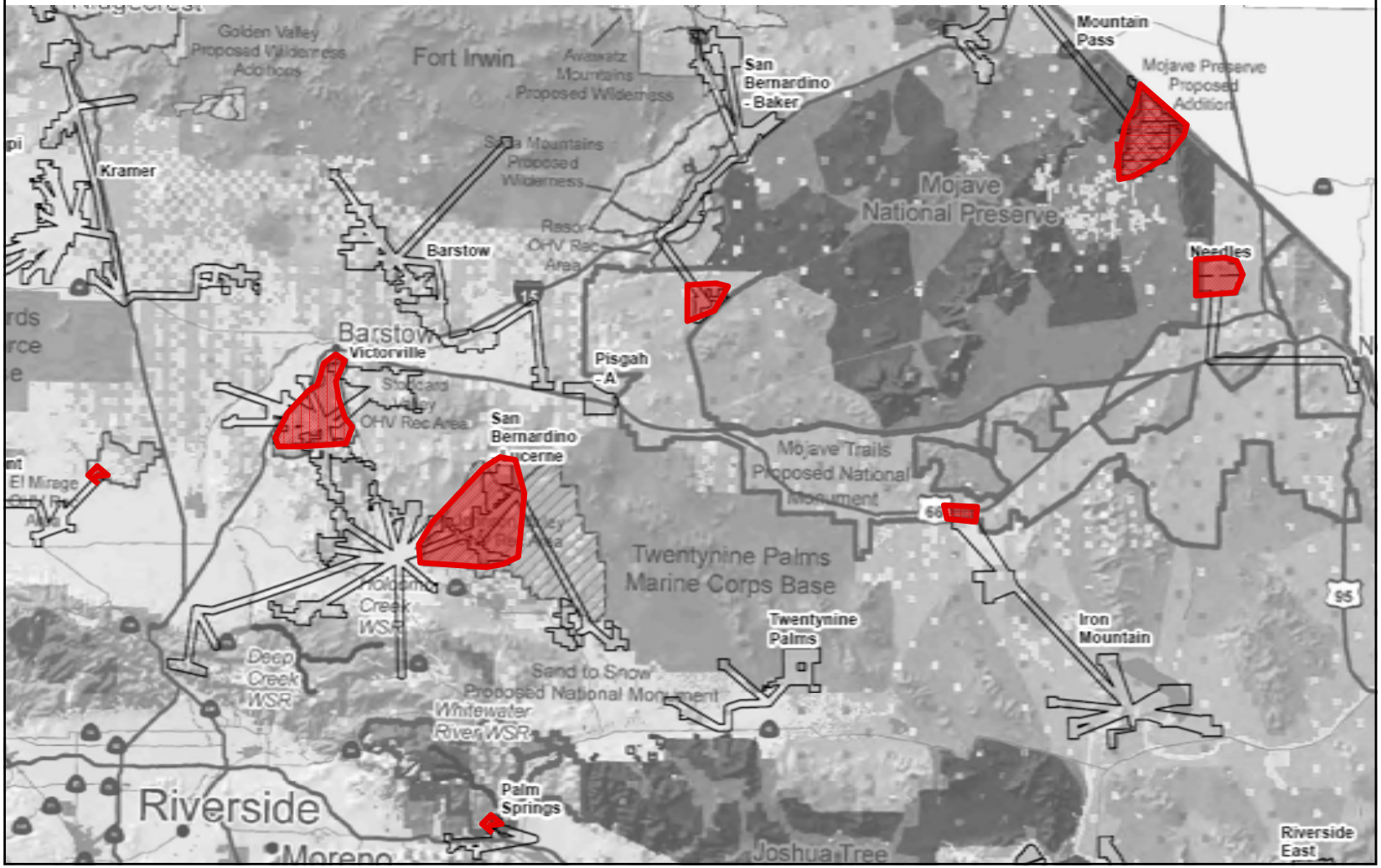
Impacts of 2010 California Desert Protection Act

Affected CREZ areas



Impacts of California Desert Protection Act

	Wind	Solar	Total	Notes
Palm Springs	0	0	0	2 projects removed but they were already removed in Phase 2A update proecess
Needles	262	0	262	2 projects removed. Needles should be de-CREZ'ed
Iron Mountain	0	400	400	About half the area (41%) for PG&E project impacted. Assumed 50% of 800 MW. This project moved to Pisgah in Phase 2A.
Mountain Pass	699	0	699	5 wind projects removed by expansion of Mojave National Preserve
San Bernardino - Baker	0	320	320	1 solar project impacted
San Bernardino - Lucerne	0	800	800	4 proxy solar project removed by Johnson Valley OHV Rec area; assumed 2 winf projects (292 MW) OK in this area.
Victorville	0	0	0	One 86 MW wind project removed in Stoddard Valley OHC Rec Area. Assumed OK.
Fairmont	0	200	200	200 MW proxy solar project removed by El Mirage OHV Rec Area
	961	**1720**	**2681**	

Capacity Estimates after CDPAct Adjustments

Assuming all are made – and wind in OHV areas can be kept

	Phase 1B to Phase 2A			Phase 2A to Phase 2A Update		Ph 2A Update to CDPAct	
CREZ	Phase 1B	Phase 2A	Change	2A Update	Change	After CDPAct	Change
Barstow	2,136	2,336	200	2,336	0	2,336	0
Carrizo North	1,600	1,600	0	1,600	0	1,600	0
Carrizo South	3,000	3,877	877	3,877	0	3,877	0
Cuyama	400	800	400	800	0	800	0
Fairmont	6,918	3,518	-3,400	2,850	-668	2,650	-200
Imperial East	1,723	1,623	-100	1,623	0	1,623	0
Imperial North-A	1,370	1,370	0	1,370	0	1,370	0
Imperial North-B	1,830	1,830	0	1,830	0	1,830	0
Imperial South	3,745	3,715	-30	3,715	0	3,715	0
Inyokern	2,887	2,432	-455	2,432	0	2,432	0
Iron Mountain	5,662	4,912	-750	4,912	0	4,512	-400
Kramer	6,627	6,412	-215	6,412	0	6,412	0
Lassen North-A	821	1,467	646	1,467	0	1,467	0
Lassen North-B	2,001	0	-2,001	0	0	0	0
Lassen South-A	410	410	0	410	0	410	0
Lassen South-B	1,200	0	-1,200	0	0	0	0
Mountain Pass	2,878	1,658	-1,220	1,658	0	959	-699
Needles	1,061	461	-600	461	0	199	-262
Owens Valley	1,400	1,400	0	5,000	3,600	5,000	0
Palm Springs	770	770	0	333	-437	333	0
Pisgah-A	1,800	2,550	750	2,550	0	2,550	0
Pisgah-B	3,790	0	-3,790	0	0	0	0
Riverside East-A	1,000	10,550	9,550	10,550	0	10,550	0
Riverside East-B	6,800	0	-6,800	0	0	0	0
Round Mountain-A	240	384	144	384	0	384	0
Round Mountain-B	187	187	0	187	0	187	0
San Bernardino - Baker	1,200	3,670	2,470	3,670	0	3,350	-320
San Bernardino - Lucerne	4,290	3,030	-1,260	3,030	0	2,230	-800
San Diego North Central	281	281	0	281	0	281	0
San Diego South	678	678	0	678	0	678	0
Santa Barbara	433	433	0	433	0	433	0
Solano	894	894	0	894	0	894	0
Tehachapi	9,642	10,837	1,195	10,425	-412	10,425	0
Twentynine Palms	800	1,805	1,005	1,805	0	1,805	0
Victorville-A	800	1,636	836	1,636	0	1,636	0
Victorville-B	895	0	-895	0	0	0	0
Victorville-C	340	0	-340	0	0	0	0
Westlands	0	0	0	5,000	5,000	5,000	0
Total	**82,509**	**77,526**	**-4,983**	**84,609**	**7,083**	**81,928**	**-2,681**

Steps To Finish

- Finalize CA GIS Shapefiles and reconcile any differences
- Incorporate “20 MW” distributed PV projects
- Include in-state transmission costs
- Re-run overall supply curve model
- Bubble chart
- Perform sensitivity and uncertainty analysis

Thank You!

Ryan Pletka

650 California, Fifth Floor

San Francisco, CA 94108

1-415-693-9552

ext. 14 Ryan

ext. 15 Tim